

Amendments to the Claims:

This listing of claims will replace all prior versions, and listings, of claims in the application:

Listing of Claims:

1. (Original) A phase change memory device, comprising:
a volume of memory material that includes:
a plurality of discrete layers of phase change material, and
a discrete layer of interface material disposed between each pair of adjacent phase change material layers, wherein the interface material is formed of a lattice mismatch material relative to the phase change material; and
means for applying heat to the memory material volume;
wherein a resistivity of the memory material is programmable to one of a plurality of generally distinct resistivity values in response to the heat applied to the memory material.
2. (Original) The phase change memory device of claim 1, wherein each of the phase change material layers includes a chalcogenide material.
3. (Original) The phase change memory device of claim 1, wherein the number of generally distinct resistivity values of the memory material volume exceeds by one the number of the phase change material layers in the memory material volume.
4. (Original) The phase change memory device of claim 1, wherein as the heat is applied over time to the memory material, the memory material exhibits periods of slower crystallization or amorphousization corresponding to the generally distinct resistivity values, and periods of faster crystallization or amorphousization corresponding to resistivities between the generally distinct resistivity values.

5. (Original) The phase change memory device of claim 1, wherein as the heat is applied to the memory material, the plurality of phase change material layers are crystallized or amorphousized generally in a sequential manner.

6. (Original) The phase change memory device of claim 1, wherein the means for applying the heat applies the heat as one or more thermal pulses.

7. (Original) The phase change memory device of claim 1, wherein the means for applying heat comprises a laser that directs a first laser beam onto the memory material volume.

8. (Original) The phase change memory device of claim 7, wherein the laser directs a second laser beam onto the memory material volume, and the phase change memory device further comprises:

an optical sensor that measures a property of the second laser beam after the second laser beam reflects off of the memory material volume.

9. (Original) The phase change memory device of claim 1, wherein the means for applying heat comprises an electrode in electrical contact with the memory material volume, and wherein the electrode generates the heat as electrical current is passed therethrough.

10. (Original) The phase change memory device of claim 1, wherein the means for applying heat comprises a first electrode and a second electrode in electrical contact with the memory material volume, and wherein the heat is generated via electrical current passing through the first and second electrodes and the memory material volume.

11. (Original) The phase change memory device of claim 10, wherein the second electrode has a resistivity that is higher than that of the first electrode so that the second electrode generates the heat to create a temperature gradient across the memory material volume.

12. (Currently Withdrawn) The phase change memory device of claim 10, further comprising:

- a substrate;
- insulation material formed over the substrate and including a hole formed therein;
- spacer material disposed in the hole and having a surface that defines an opening having a width that narrows along a depth of the opening;
- the first electrode is disposed in the hole and has an upper surface;
- the volume of memory material is disposed in the opening and extends along the spacer material surface and at least a portion of the first electrode; and
- the second electrode is disposed in the opening and on the volume of memory material; wherein the second electrode and the volume of memory material form an electrical current path that narrows in width as the current path approaches the first electrode, so that electrical current passing through the current path generates the heat for heating the volume of memory material.

13. (Currently Withdrawn) The phase change memory device of claim 12, wherein the current path reaches a minimum cross sectional area adjacent the first electrode upper surface.

14. (Currently Withdrawn) The phase change memory device of claim 12, wherein the first electrode is disposed in the opening defined by the spacer material surface.

15. (Currently Withdrawn) The phase change memory device of claim 12, wherein the spacer material is formed over the first electrode upper surface.

16. (Currently Withdrawn) The phase change memory device of claim 15, wherein an indentation is formed into the first electrode upper surface, and a portion of the memory material volume extends into the indentation.

17. (Currently Withdrawn) An phase change memory device, comprising:
a plurality of memory cells formed on a substrate, wherein each of the memory cells includes:

- a volume of memory material that includes a plurality of discrete layers of phase change material, with a discrete layer of interface material disposed between each pair of adjacent phase change material layers, wherein the interface material is formed of a lattice mismatch material relative to the phase change material;
- a first electrode in electrical contact with the memory material volume; and
- a second electrode in electrical contact with the memory material volume,

wherein the volume of memory material is disposed between the first and second electrodes such that electrical current passing through the first and second electrodes and the memory material volume generates heat that is applied to memory material;

wherein a resistivity of the memory material in each of the memory cells is programmable to one of a plurality of generally distinct resistivity values in response to the heat applied thereto.

18. (Currently Withdrawn) The phase change memory device of claim 17, wherein each of the phase change material layers includes a chalcogenide material.

19. (Currently Withdrawn) The phase change memory device of claim 17, wherein for each of the memory cells, the number of generally distinct resistivity values of the memory material volume exceeds by one the number of the phase change material layers in the memory material volume.

20. (Currently Withdrawn) The phase change memory device of claim 17, wherein for each of the memory cells, as the heat is applied over time to the memory material, the memory material exhibits periods of slower crystallization or amorphousization corresponding to the generally distinct resistivity values, and periods of faster crystallization or amorphousization corresponding to resistivities between the generally distinct resistivity values.

21. (Currently Withdrawn) The phase change memory device of claim 17, wherein for each of the memory cells, the second electrode has a resistivity that is higher than that of the first electrode so that the second electrode generates the heat to create a temperature gradient across the memory material volume.

22. (Currently Withdrawn) The phase change memory device of claim 21, wherein for each of the memory cells, as the heat is applied to the memory material, the plurality of phase change material layers are crystallized or amorphousized generally in a sequential manner.

23. (Currently Withdrawn) The phase change memory device of claim 17, wherein each of the memory cells further comprises:
insulation material formed over the substrate and including a hole formed therein;
spacer material disposed in the hole and having a surface that defines an opening having a width that narrows along a depth of the opening;
the first electrode is disposed in the hole and has an upper surface;
the volume of memory material is disposed in the opening and extends along the spacer material surface and at least a portion of the first electrode; and
the second electrode is disposed in the opening and on the volume of memory material;
wherein the second electrode and the volume of memory material form an electrical current path that narrows in width as the current path approaches the first electrode, so that electrical current passing through the current path generates the heat for heating the volume of memory material.

24. (Currently Withdrawn) The phase change memory device of claim 23, wherein for each of the memory cells, the current path reaches a minimum cross sectional area adjacent the first electrode upper surface.

25. (Currently Withdrawn) The phase change memory device of claim 23, wherein for each of the memory cells, the first electrode is disposed in the opening defined by the spacer material surface.

26. (Currently Withdrawn) The phase change memory device of claim 23, wherein for each of the memory cells, the spacer material is formed over the first electrode upper surface.

27. (Currently Withdrawn) The phase change memory device of claim 26, wherein for each of the memory cells, an indentation is formed into the first electrode upper surface, and a portion of the memory material volume extends into the indentation.

Claims 28-40: Previously Cancelled.